iadis international conference

# WWW/Internet 2006

5 - 8 October 2006 - Murcia, SPAIN

## PROCEEDINGS
## Volume II

Edited by:
Pedro Isaías
Miguel Baptista Nunes
Inmaculada J. Martínez

iadis
international association for development of the information society

## IADIS INTERNATIONAL CONFERENCE

# WWW/INTERNET 2006

# PROCEEDINGS OF THE IADIS INTERNATIONAL CONFERENCE
# WWW/INTERNET 2006

## Volume II

**MURCIA, SPAIN**

**OCTOBER 5 - 8, 2006**

Organised by
**IADIS**
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# FOREWORD

These proceedings contain the papers and posters of the IADIS International Conference WWW/Internet 2006, which was organised by the International Association for Development of the Information Society and co-organised by Universidad de Múrcia – Facultad de Comunicación y Documentación in Murcia, Spain, October 5 – 8, 2006.

The purpose of this conference is to serve as a forum to gather researchers, practitioners, students and anyone who works or studies the field of WWW/Internet. The following fifty-seven areas have been object of paper and poster submissions:

Accessibility; Adaptive Web Systems; Collaboration; Computer-Mediated Communication; Data Mining; Database Planning and Development; Digital Economy; Digital Libraries and E-Publishing; Distributed and Parallel Applications; E-Business and E-Commerce; E-Government; E-Learning; Electronic Data Interchange; Quality, Evaluation and Assessment; Extensible Languages; Global Tendencies in WWW/Internet; Groupware; Human Computer Interaction; Hypermedia; Information Architectures; Information Visualization; Intelligent Agents; Interfaces; Internet & Customer Relationship Management; Internet Payment Systems; Internet Services; Languages; Metadata; Performance Issues; Personalized Web Sites and Services; Portal strategies; Protocols and Standards; Searching and Browsing; Security Issues; Semantic Web; Social & Legal Issues; Storage Issues; System Integration; Teaching and Learning Strategies; Technology Innovation and Competitiveness; Technology Management; Technology Strategies; Tele-Work; WWW/Internet Applications; WWW/Internet Case studies; WWW/Internet Impacts; Web Engineering; Web Personalization; Web Software; Wireless Applications; Ubiquitous Computing; Usability; User Modelling; Virtual Communities; Virtual Reality; XML.

The IADIS WWW/Internet 2006 Conference had 286 submissions from more than 29 countries. Each submission has been anonymously reviewed by at least two independent reviewers, to ensure the final high standard of the accepted submissions. The final result was the approval of 71 full papers, which means that the acceptance rate was below 25%. A few more papers have been accepted as short papers and posters. Best papers will be selected for publishing as extended versions in the *IADIS International Journal on WWW/Internet* (IJWI*)*.

The conference, besides the presentation of full papers, short papers, posters, and doctoral consortium presentations also included keynote presentations and a tutorial from internationally distinguished researchers.

As we all know, organising a conference requires the effort of many individuals. We would like to thank all members of the Program Committee for their hard work in reviewing and selecting the papers that appear in the proceedings.

These volumes have taken shape as a result of the contributions from a number of individuals. We are grateful to all authors who have submitted their papers to enrich the conference proceedings. We would like also to express our gratitude to Professor Katia Sycara, Director of the Intelligent Software Agents Lab, Carnegie Mellon University, USA, and to Professor Fausto Giunchiglia, Head of the Department of Information and

Communication Technology, University of Trento, Italy, for accepting our invitation as keynote speakers. We wish to thank all members of the local organizing committee in Murcia, sponsors, delegates, invitees and guests whose contribution and involvement are crucial for the success of the conference.

Each of the Proceedings contains a rich experience of the academic & research institutions and the industry on diverse themes related to the Internet and Web. We do hope that researchers, knowledge workers and innovators both in academia and the industry will find it a valuable reference material.

Last but not the least, we hope that everybody will have a good time in Murcia, and we invite all participants for the next year edition of the *IADIS International Conference WWW/Internet 2007*.

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# USING WQM FOR CLASSIFYING USABILITY METRICS

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**ABSTRACT**

Quality is an essential characteristic for web success. Several authors have described different methodologies, guidelines, techniques and tools in order to assure the quality of web sites. Among them the WQM model (Web Quality Model), which distinguishes three dimensions related to web features, lifecycle processes and quality characteristics. This last dimension is based on the ISO 9126 standard being usability one of the defined quality characteristic. In this paper, we classify some usability metrics using this framework.

**KEYWORDS**

Quality, models, usability, metrics.

## 1. INTRODUCTION

Nowadays it is very common to apply metrics in the development of systems. Metrics are used as mechanisms for evaluating the quality of the product in terms of efficiency, portability, usability, maintainability, reliability and functionality (ISO, 2001; Landauer, 1995). Then software development and maintenance projects can be understood, controlled, supervised, guessed and predicted by using metrics (Briand, 1996) and, in many cases the difference between two systems can be something so simple and so important like applying quality.

Usability metrics are important in order to do a product easy to use. Usability can help to make a system nearer to the final user. If a system is usable, it is easy to learn how to use it productively (Constantine, 1999).

In this paper we present a some usability metrics some authors consider important, then these metrics are classified using WQM, a three-dimensional quality model proposed by (Calero, 2004).

A quality model defined for supporting a given kind of analysis, is a description of which attributes are important for the analysis and which measurement methods have to be used to assess the attributes values (Brajnik, 2002). In web site design, a quality model is essentially a set of criteria that are used to determine if a website reaches certain levels of quality.

Next section will explain why to use WQM and usability metrics in this proposal. Section 3 shows the selected metrics which are going to be classified. The classification of the metrics will come on section 4 and the paper will finish with the conclusions and further work on section 5.

## 2. WEB QUALITY MODEL (WQM) AND USABILITY

We have selected WQM (Calero, 2004) as a quality model for classifying metrics because is composed by three dimensions, a quality dimension, a life cycle processes dimension and a web features dimension. So, by classifying a metric using this model we will know more about the metric. In that way we think it is fundamental to know who can use the metric and when to use it.

WQM included the three "classic" Web Aspects in a dimension: *Content*, *Presentation* and *Navigation*. The description of the Quality Characteristics Dimension is based on the Quint2 model (Niessink, 2002) which is based on the ISO 9126 standard (ISO, 2001): Functionality, Reliability, Usability, Efficiency, Portability and Maintainability. Lastly, the Life Cycle Processes dimension includes the diverse processes of the web site life cycle following the ISO 12207 standard (ISO, 1995).

Computer systems built with usability (ISO, 1998; ISO, 2001) criteria have several benefits such as productivity improvement, cost and learning time reduction and a notable increment of final user autonomy.

In (Landauer, 1995) the author stated that 80% of maintenance costs are due to user-system interaction problems and not to technical problems. Besides, the author indicates that 64% of these costs are related with usability problems.

This situation highlights the importance of usability and justifies the need to incorporate usability criteria before, during and after software systems development.

# 3. USABILITY METRICS

There are a lot of usability metrics which take care on the web user interface. In general, those metrics can be classified into three broad categories (Constantine, 1999): *structural metrics*, based on surface properties; *semantic metrics*, which are content sensitive; or *procedural metrics*, which are task sensitive.

There are also proposed a group of five metrics called *essential usability metrics suite*, which is composed by: *essential efficiency*, *task concordance*, *task visibility*, *layout uniformity* and *visual coherence*.

Such a suite was proposed as the best set of metrics to measure the usability of a user interface and this is the reason why we have selected them for be classified into WQM.

## 3.1. Essential Usability Metrics Suite

This suite was defined by (Constantine, 1999) and is composed by five metrics that must to be used together because none of them is, by itself, an indicator of the quality of a system.

The suite, that their authors argue can improve the usability in every software, is composed by: essential efficiency, task concordance, task visibility, layout uniformity and visual coherence.

Metrics one to three are procedural metrics, layout uniformity is a structural metric and visual coherence can be considered as a semantic metric.

**Essential efficiency** tries to measure how near is the user interface design from the ideal use case for making a particular task. That is, it is a ratio between the number of essential steps that are needed for a user to get an objective and the number of steps actually needed to get it.

$$EE = 100 \cdot \frac{S_{essential}}{S_{enacted}}$$

**Task concordance** is based in use cases and evaluates task efficiency and simplicity. It is an indicator about the difficulty of the most frequent tasks. Thereby, a system would be better than other system if the most frequently used tasks are simpler.

This is the only metric which takes values from -100% to +100%. When the most frequently used tasks are the simplest, then task concordance takes the 100% value. On the other hand, if the most frequently used tasks are the tasks needing the most number of steps for completing, then task concordance takes the -100% value.

$$TC = 100 \cdot \tau = 100 \cdot \frac{D}{P}$$

D = number of pairs of tasks ranked in correct order by enacted length less number of pairs out of order.
P = number of possible tasks pairs.

**Task visibility** metric is grounded in the Visibility Principle (user interfaces only should show what users need to do a particular thing). It measures the relationship between visibility of characteristics and the capacity needed to finish a task or a set of tasks.

$$TV = 100 \cdot \left( \frac{1}{S_{total}} \cdot \sum_{\forall i} V_i \right)$$

$S_{total}$ = number of steps to complete use cases

$V_i$ = feature visibility (0 to 1) of enacted step *i*.

**Layout uniformity** is well known that developers do not have a graphic designer's eye, or at least, it is not very common. Then, this metric measures the layout of the different objects in the user interface without taking account into the functionality of these items what they are or what they do.

$$LU = 100 \cdot \left( 1 - \frac{(N_h + N_w + N_t + N_l + N_b + N_r) - M}{6 \cdot N_c - M} \right)$$

$N_c$ = number of visual components on the interface.

$N_h, N_w, N_t, N_l, N_b, N_r$ = heights, widths, alignments… between components.

*M* = this is an adjustment to make the layout uniformity value from 0 to 100.

**Visual coherence** metric is based on the distance between related visual components. And works taking into account that for users it is easier to find what they are looking for in a well structured user interface. This happens because all related items are near each other and non related items are distant.

$$VC = 100 \cdot \left( \frac{\sum_{\forall k} G_k}{\sum_{\forall k} N_k \cdot (N_k - 1)/2} \right)$$

With $G_k = \sum_{\forall i, j | i \neq j} R_{i,j}$

Where $N_k$ = number of visual components into the group *K*.

$R_{i,j}$ = semantic relation between *i* and *j* components into the set *k*, $0 \leq R_{i,j} \leq 1$

## 3.2. Other selected metrics

There are other metrics which are mentioned as previous work in usability measurements by (Constantine, 1996) like other yardsticks. These metrics have been also taken into account for being classified into WQM.

**Layout Complexity** metric (Comber, 1994; Comber, 1995) is based in sizes and positions distribution of visual objects. A layout is more complex when height and width variations in visual components and the distance from the edges of the visual interaction context are bigger. Layout complexity can be considered as structural metric.

**Layout Appropriateness** metric, proposed by (Sears, 1993) is a procedural metric which estimates the efficiency of a screen in terms of cost for completing a collection of tasks.

A system is better if visual components which do related tasks are closer because the time needed to complete them is reduced.

Conceptual and semantic relationships among internal parts of a particular visual component are measured by **data cohesion** (Yourdon, 1979) metric. Data cohesion can be classified as a procedural metric.

The strength of interconnection or the degree of interdependence between two components is measured by **coupling** metric (Yourdon, 1979). This can be considered also as a procedural metric.

# 4. CLASSIFICATION WITHIN WQM

Once the metrics selected have been shown, we will explain the classification criterions used. As it was detailed in point 2, classification within WQM (Calero, 2004) takes into account Web features, quality characteristics (ISO, 2001; Landauer, 1995) and lifecycle processes (ISO, 1995). How to decide which exact web feature, quality characteristic or lifecycle process are related to a metric has been done based mainly, on the information given by authors.

However, most of the times, this information is not given by authors. In that case, we have used our own criteria based on our experience on web quality. For example, when talking about web features, if the metric we want to classify seems to measure something related to aspects of moving around the Web, accessing to data, information or similar, this metric has been classified as navigation aspect rather than the others. Related to quality characteristics, if a metric measures, for example, how easy is to do a particular task for a user, it has been classified, obviously, as *usability*, but also as *efficiency*. Finally, the third dimension is about phases in lifecycle processes. In that case, for classifying the metric, we must decide when the metric could be used. There are a lot of metrics that can be useful in several processes. In these cases, we have decided to classify the metric on all of them.

## 4.1. Metrics classification

Based on the criterions described on the last point, we present, in Table 1, the classification of the metrics explained in the section 3.1 using WQM. In this table, the name of the metric, the author and the classification within the model will be shown.

## 4.2. Results

As we have considered only usability metrics to be classified into WQM, usability always appears as quality characteristic, but what is really interesting is the relationship of usability metrics with the other dimensions proposed in WQM, and even within the quality dimension.

For example, a *usability* metric classified in WQM usually is related with *efficiency* and *functionality* in the quality characteristics dimension. In the lifecycle processes dimension, usability is usually connected to *architectural design*, *system analysis*, and *maintenance*. And finally, in the Web feature dimension is related with *content* and *presentation*.

Table 1**.** Usability metrics classification

| **Metric Name** | **Author** | **Web features** | **Quality characteristics** | **Life Cycle processes** |
|---|---|---|---|---|
| Essential efficiency | Constan-tine, 1999 | content, navigation | efficiency, usability, functionality | systems analysis, validation, operation, maintenance |
| Task concordance | | content | efficiency, usability, functionality | verification, systems analysis, validation, operation, maintenance |
| Task visibility | | content, presentation | efficiency, usability, functionality | architectural design, implementation, systems analysis, validation, maintenance |
| Layout uniformity | | presentation | Usability | architectural design, systems analysis, validation, operation, maintenance |
| Visual coherence | | content, presentation, navigation | efficiency, usability, functionality | architectural design, systems analysis, validation, operation, maintenance |
| Layout Appropriateness | Sears, 1993 | presentation, navigation | efficiency, usability, maintainability, functionality | Lifecycle process: requirements analysis, architectural design, implementation, integration, systems analysis, operation, maintenance |
| Layout Complexity | Comber, 1994 -95 | presentation | Usability | architectural design, implementation, systems analysis, validation, maintenance |
| Data cohesion | Yourdon, 1979 | Content | efficiency, portability, usability, maintainability | Lifecycle process: architectural design, implementation, integration, systems analysis, maintenance |
| Coupling | | content | efficiency, portability, usability, maintainability | Architectural design, implementation, integration, systems analysis, maintenance |

## 5. CONCLUSIONS AND FUTURE WORKS

There are many web usability metrics proposed. However, more information is needed in order to systemize its use. In order to give more information about the metrics we have used WQM, a three dimensional web quality model (composed by web features, quality characteristics and life-cycle processes) and we have surveyed some of the most relevant web usability metrics.

As a result of our classification we have found that it seems that a *usability* metric classified in WQM usually is related with *efficiency* and *functionality* in the quality characteristics, in the lifecycle process dimension is usually connected to *architectural design*, *system analysis*, and *maintenance*. And finally, in the Web feature dimension is related with *content* and *presentation*.

Nevertheless, this is only a first approach that needs to be reviewed and completed including more usability metrics in order to obtain definite conclusions about the usability metrics defined into the literature. For example, once the study will be completed, we will know in which life cycle processes or for what stakeholders there are not metrics defined. In that way, we will be able to define new metrics for these cases. Another conclusion derived from the completed model will allow us to know in which cell of the cube the biggest metric definition effort has been done having a guideline about the factors that are considered the most important for the web metric researchers.

## ACKNOWLEDGEMENT

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